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US005868675A

## United States Patent [19]

Henrion et al.

[11] Patent Number: 5,868,675

[45] Date of Patent: \*Feb. 9, 1999

[54] INTERACTIVE SYSTEM FOR LOCAL  
INTERVENTION INSIDE A  
NONHOMOGENEOUS STRUCTURE

5,409,497 4/1995 Siczek et al. 606/130  
5,572,999 11/1996 Fubda et al. 600/407

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Paris, all of France

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[73] Assignee: Elekta IGS S.A., Gieres, France

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11th Annual International Conference, vol. 11, pp. 926-927,  
Nov. 1989.

[\*] Notice: The terminal 36 months of this patent has  
been disclaimed.

Watanabe, E et al. Three-Dimensional Digitizer (Neu-  
ronavigator): New Equipment for Computed Tomogra-  
phy-Guided Stereotaxic Surgery. Surg. Neurol., vol. 27, pp.  
543-547, 1987.

[21] Appl. No.: 847,059

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[86] PCT No.: PCT/FR90/00714

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[30] Foreign Application Priority Data

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[51] Int. Cl.<sup>6</sup> A61B 5/05

[52] U.S. Cl. 600/424; 606/130

[58] Field of Search 128/653.1; 378/4,  
378/20, 41, 58, 205; 606/130; 901/6, 16,  
41; 600/407, 411, 415, 417, 424

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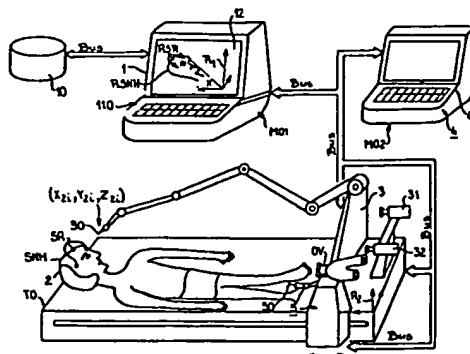
Primary Examiner—Brian Casler

Attorney, Agent, or Firm—Blakely Sokoloff Taylor &  
Zafman

## [57] ABSTRACT

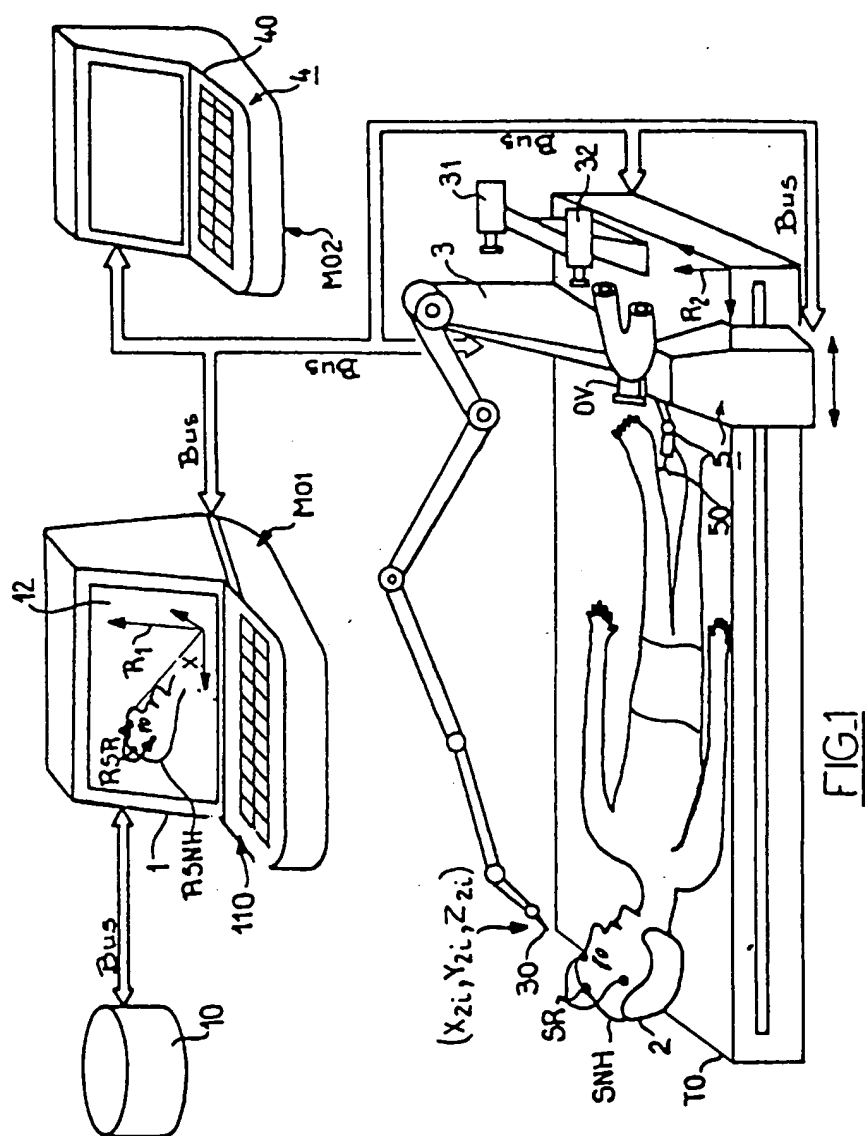
An interactive system for a local intervention inside a region of a non-homogeneous structure, such as the skull of a patient, which is related to the frame of reference ( $R_2$ ) of an operation table, and which is connected to a reference structure comprising a plurality of base points. The system creates on a screen a representation of the non-homogeneous structure and of the reference structure connected thereto, provides the coordinates of the images of the base points in the first frame of reference ( $R_1$ ), allows the marking of the coordinates of the base points in  $R_2$ , and allows the carrying out of the local intervention with an active member such as a trephining tool, a needle, or a radioactive or chemical implant. The system also optimizes the transfer of reference frames between  $R_1$  and  $R_2$ , from the coordinates of the base points in  $R_2$  and the images in  $R_1$ , by reducing down to a minimum the deviations between the coordinates of images in  $R_1$  and the base points in  $R_1$ , after transfer. The system also establishes real time bi-directional coupling between: (1) an origin and a direction of intervention simulated on the screen, (2) the position of the active member.

16 Claims, 13 Drawing Sheets



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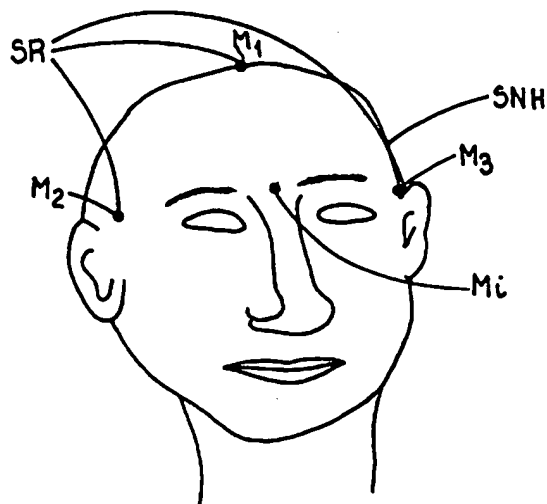


FIG. 2

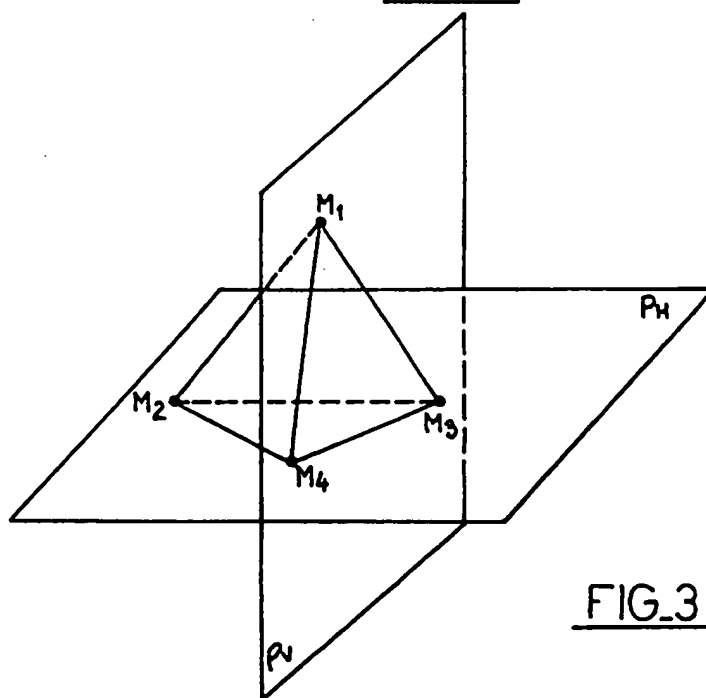
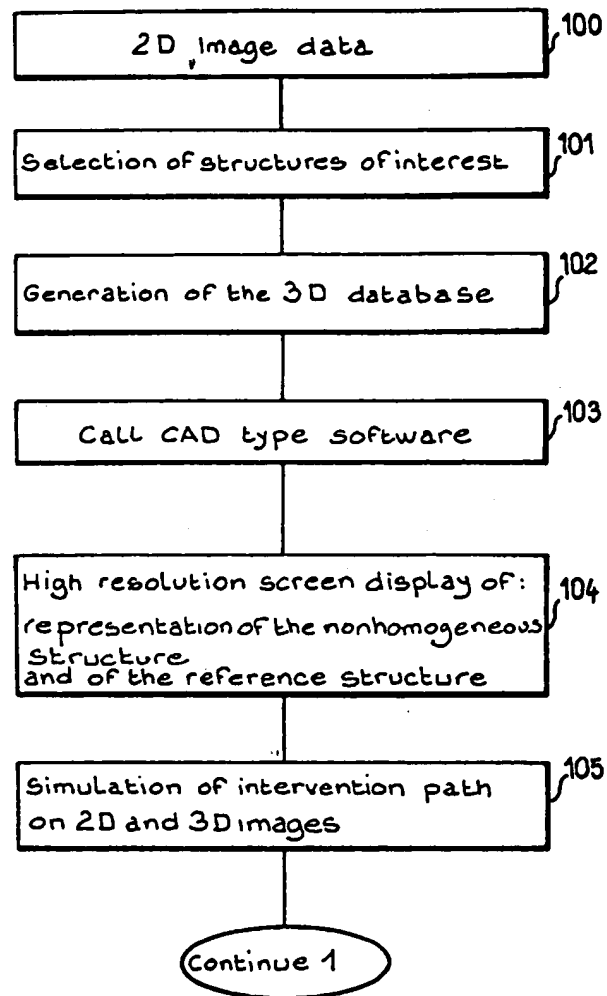
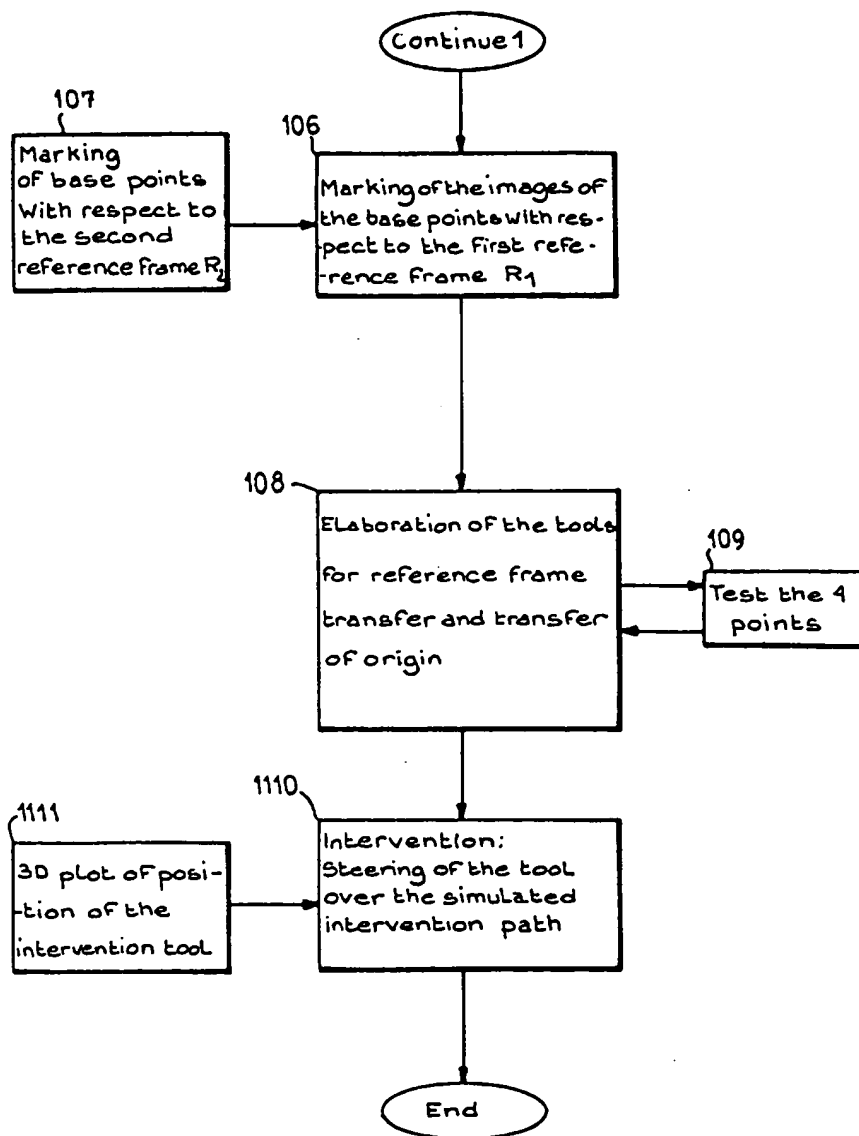


FIG. 3



FIG. 5a

FIG. 5b



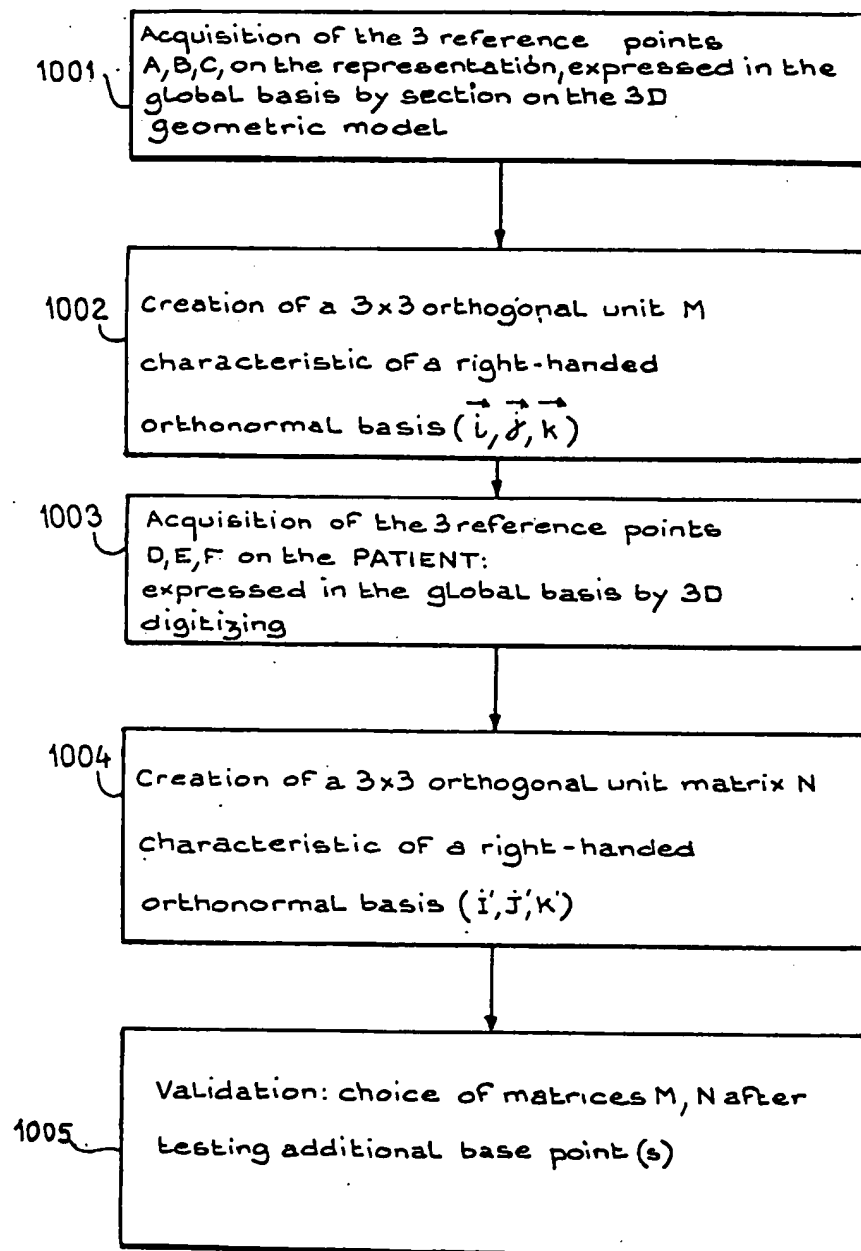
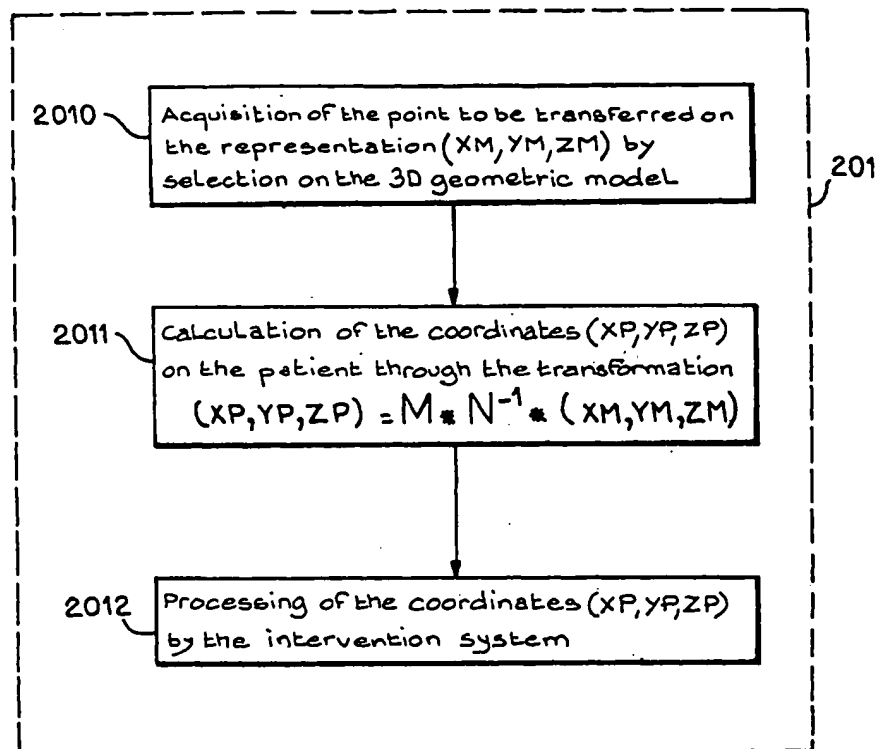
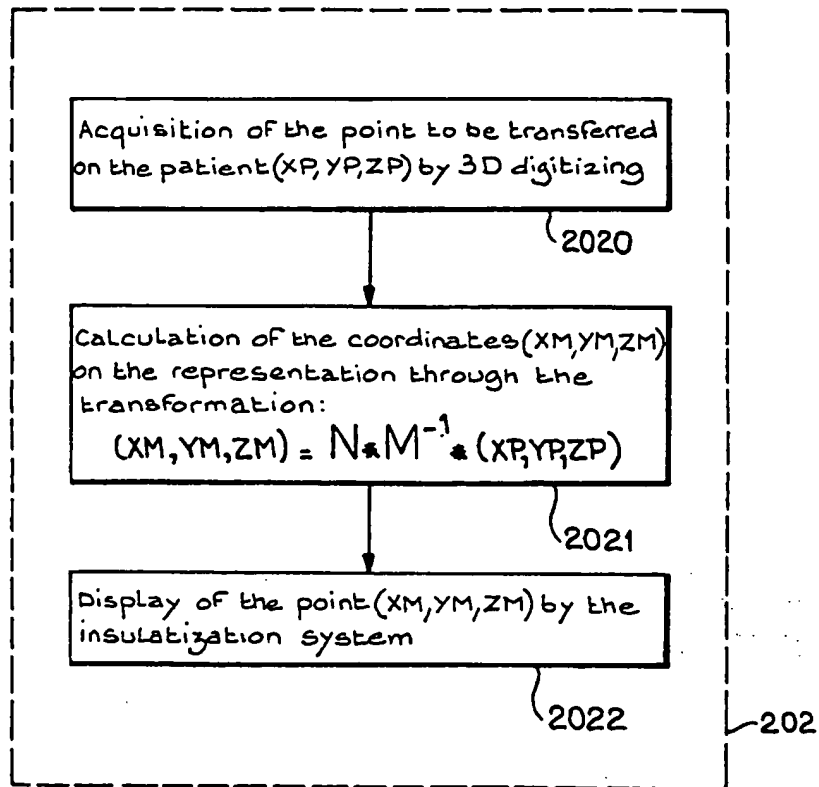


FIG 6

FIG. 7

FIG. 8